ARIZ. UNIV. LIB. SEP 10 1913

Twenty-third Annual Report

OF THE

North Dakota Agricultural Experiment Station

AGRICULTURAL COLLEGE
NORTH DAKOTA

TO

THE GOVERNOR OF NORTH DAKOTA

1913

Twenty-third Annual Report

OF THE

North Dakota Agricultural Experiment Station

AGRICULTURAL COLLEGE
NORTH DAKOTA

TO

THE GOVERNOR OF NORTH DAKOTA

1913

LETTER OF TRANSMITTAL

Agricultural College, N. Dak., February 1, 1913.

Hon. L. B. Hanna, Governor of the State of North Dakota.

Sir:—As required by Act of Congress, approved March 2nd, 1887, I hereby submit the Twenty-third Annual Report of the North Dakota Experiment Station for the year ending February 1st, 1913, together with a financial statement of receipts and disbursements, as required by law, for the government of fiscal year ending June 30th, 1912.

Respectfully,

CLARK W. KELLEY,

President of the Board of Trustees,

North Dakota Agricultural College.

UNIVERSITY OF ARIZONA
630.72
N874
LIBRARY

STATION STAFF

BOARD OF TRUSTEES

CLARK W. KELLEY, President, Devils Lake, N. D.
G. H. HOLLISTER, Fargo, N. D.
H. D. MACK, Dickey, N. D.
C. E. NUGENT, Fargo, N. D.
PETER ELLIOTT, Fargo, N. D.
FRANK SANFORD, Valley City, N. D.
JOHN DONELLY, Grafton, N. D.
W. A. YODER, Secretary, Agricultural College
W. P. PORTERFIELD, Treasurer, Fargo, N. D.
J. H. WORST, LL. D., Director.

AGRICULTURAL DEPARTMENT

J. H. SHEPPERD, M. S. A., Vice-Director and Agriculturist.
W. B. RICHARDS, B. S. A., Assistant Agriculturist (Animal Husbandry.)
R. C. DONEGHUE, M. S. A., Assistant Agriculturist, (Soil Investigations.)
O. W. DYNES, B. S. A., Assistant Agriculturist (Plant Breeding and Poultry).
C. F. CHASE, B. S., Assistant Agriculturist (Engineering).
G. L. MARTIN, B. S. A., Assistant Agriculturist (Dairying).
E. J. THOMPSON, B. S., Assistant Agriculturist (Animal Husbandry).

BIOLOGY

H. L. BOLLEY, M. S., Botanist and Plant Pathologist.
W. B. BELL, Ph. D., Assistant Biologist (Economic Survey).
E. S. REYNOLDS, Ph. D., Assistant Botanist (Mycology and Plant Survey).
C. J. T. DORYLAND, M. S., Assistant Botanist (Soil Bacteriology).
O. A. STEVENS, B. S., Assistant Botanist (Seed Analysis).
D. G. MILBRATH, A. B., Assistant Botanist (Mycology and Histology).
NEVADA S. EVANS, Assistant Botanist (Seed Analysis).
W. H. MERCER, B. S. A., Assistant Botanist (Plant Breeding).
G. E. MILLER, A. M., Assistant Botanists (Economic Survey).

60156

CHEMISTRY

E. F. LADD, B. S., Chemist.
W. F. SUDRO, B. S., Assistant Chemist (Drugs).
R. E. REMINGTON, A. B., Assistant Chemist (Foods).
W. L. STOCKHAM, M.. S., Assistant Chemist (Oils).
J. W. INCE, A. M., Assistant Chemist, (Soils).
H. L. WHITE, M. A., Assistant Chemist (Cereals).
ADOLPH ZIEFLE, Ph. C., B. S., Assistant Chemist (Drugs).
L. A. CONGDON, B. S., Assistant Chemist (Foods).
LEVI THOMAS, M. S. Assistant Chemist (Baking).
M. L. DOLT, Ph. D., Assistant Chemist (Textile Fibers).
C. T. GUTHRIE, B. Pd., Ph. C., Assistant Chemist (Drugs).
J. H. WRIGHT, M. S., Assistant Chemist (Microscopy).
W. F. WASHBURN, M. S., Assistant Chemist (Paints).
RALPH DARNER, A. M., Assistant Chemist (Oils and Varnishes)
ADELE SHEPPERD, Assistant Chemist (Waters).
THOMAS SANDERSON, Miller.

HORTICULTURE AND FORESTRY

C. B. WALDRON, B. S., Horticulturist and Forester.
S. B. JOHNSON, B. S., Assistant Horticulturist.

VETERINARY

LEUNIS VAN ES, M. D., V. S., Veterinarian.
E. D. HARRIS, D. V. M., Assistant Veterinarian.
A F. SCHALK, D. V. M., Assistant Veterinarian.
C. V. KENNEDY, Farm Foreman.

SUB-STATIONS

O. A. THOMPSON, B. S., Superintendent at Edgeley.
L. R. WALDRON, M. A., Superintendent at Dickinson.
E. G. SCHOLLANDER, B. S., Superintendent at Williston.
E. D. STEWART, B. S., Superintendent at Langdon.
W. R. LANXON, Superintendent at Hettinger.

DEMONSTRATION FARMS

W. R. PORTER, M. S. A., Superintendent.
AMOS EWEN, B. S., Assistant Superintendent.

REPORT

To the Board of Trustees of the North Dakota Agricultural College and Experiment Station:

Gentlemen:

I have the honor to submit herewith the Twenty-third Annual Report of the North Dakota Government Experiment Station.

The following bulletins were published during the year:

No. 96. Some Principles of Dry Farming, L. R. Waldron.
No. 97. Barn Plans, R. M. Dolve.
No. 98. The Silo and Its Construction, J. H. Shepperd and R. M. Dolve.
No. 99. The Adjustment and Repair of Self-Binders, R. M. Dolve.
No. 100. Cropping Systems for Wheat Production, J. H. Shepperd, and R. C. Doneghue.
No. 101. Potato Warehouse Plans, R. M. Dolve.
No. 102. Organizing Cow-Testng Associations and Co-operative Creameries, G. L. Martin.

PRESS BULLETINS

No. 54. Alfalfa (in German), L. R. Waldron.
No. 55. Rabies, Dr. L. Van Es.
No. 56. Harvesting Grain for Use or Sale as Seed for Sowing Purposes, H. L. Bolley.
No. 57. Resistant Flax Seed for Sowing Purposes, H. L. Bolley.

EXPERIMENTAL WORK

The experimental work during the past year is briefly outlined by the several members of the Experimental Staff in the body of this report. Satisfactory work has been accomplished in all departments.

The work for the ensuing year will continue practically along the lines as suggested by the several department heads, inasmuch as experimental problems are usually of such a nature as requires years for their ultimate solution. Work completed or data secured that is of immediate value to farmers is published and distributed in the form of Station and Press Bulletins.

EXTENSION WORK

An annual appropriation of $20,000. was made by the 13th Legislative Assembly for extension work. The first year's allotment, however, was vetoed by the Governor so that no money will be available for the extension activities before 1914.

DAIRY LABORATORY

The 13th Legislative Assembly also appropriated the sum of $35,000. for the construction of a dairy laboratory, dairy barn, and for the purchase of a dairy herd. Altho the sum provided is too small to make a creditable showing or to meet the demands of an agricultural state in which the dairy industry should be encouraged to the utmost, both on account of the profit there is in the business and its influence upon the maintenance of soil fertility, yet a start can be made with the meagre sum appropriated.

SUB-STATIONS

The five sub-stations have fully come up to the expectation of the localities in which they are located, viz., Edgeley, Williston, Dickinson, Langdon, and Hettinger. The latter station, on account of a Legislative oversight in not completing its appropriation bill in 1911, had to be operated during the past two years practically without funds, except such as were provided by the Government and the Government Experiment Station. The work of the station, in consequence, was not pushed as energetically as was desirable. The 13th Legislative Assembly, however, made provision for this station's support as well as for the others and the work will be prosecuted with vigor in the future.

The sub-stations are conducted with a view to making demonstrations in additon to doing experimental work. The Dickinson sub-station, however, in addition to the general sub-station routine

has carried on an interesting line of experimental work with alfalfa, perhaps the most elaborate of its kind conducted anywhere in the whole country.

DEMONSTRATION FARMS

Twenty-four demonstration farms are maintained at state expense, the work being done by farmers under the superintendence of College and Station men. These farms afford encouraging data as the result of using pedigree seed and crop rotation with skillful tillage, the work being performed by actual farmers. The methods employed are strictly demonstrational, nothing being required that every farmer could not apply to his entire farm, be it large or small. It is earnestly hoped that the number of demonstration farms can be increased to not less than 100 in the near future. A reasonable portion of the people's taxes could be devoted to no better purpose than to field demonstrations that would lead to doubling the profits realized by farmers without material increase, on their part, of labor or investment of capital.

Respectfully,
J. H. WORST, Director.

AGRICULTURAL DEPARTMENT

To Director J. H. Worst:

Sir: The work of the Agricultural Department is similar to that carried heretofore in the main, although expanded and extended in several lines and with work in Farm Management added as a new feature of activity.

Inquiries for specific information have again greatly expanded and have taken considerable of the energies of myself and of my co-workers.

R. M. Dolve handed me his resignation as Assistant in Agricultural Engineering Sept. 1st, 1912, and Carl F. Chase has been selected to fill the position.

Six bulletins have been presented to you by this Department during the past year as follows:—

Bulletin No. 97 "Barn Plans" by R. M. Dolve.

Bulletin No. 98 "The Silo and Its Construction" by Shepperd, Martin and Dolve.

Bulletin No. 99 "The Adjustment and Repair of Self-Binders" by R. M. Dolve.

Bulletin No. 100 "Cropping Systems for Wheat Production" by Shepperd and Doneghue.

Bulletin No. 101 "Potato Warehouse Plans" by R. M. Dolve.

Bulletin No. 102 "Organizing Cow-Testing Associations and Co-operative Creameries" by G. L. Martin.

The experiment work carried on during the past year has been as outlined below:—

(a) 1. Cost of Milk and butter production and 2, economic rations for dairy cows.

(b) 1. Value of different varieties of pasture crops for hogs;
2. The economy of hogging off corn crops.

(c) Carrying capacity of pasture crops for cattle and sheep.

(d) Effect of ration and winter exercise on the size of litters produced by sows.

(e) Breeding for high annual milk and butter production with cows in New Salem Co-operative Breeding Project.

(f) Rations for profitable sheep fattening and the utilization of local feeds.

(g) Breeding wheat, oats, barley and flax for productive capacity.

(h) Ear to row breeding of corn for increased production and earliness.

(i) Hill selection and hill to row growing of potatoes for increased productive capacity and improved quality.

(j) Breeding winter wheat and rye for cold resistance, yield and quality.

(k) Studying depth and thickness of planting clover.

(l) Breeding alfalfa for yield and cold resistance.

(m) Cropping systems (1) effect on soil fertility (2) moisture conservation (3) physical condition of soil and (4) economic yield.

(n) Fertility (1) value of different kinds of stable manure (2) the effect of the different single elements of fertility (3) their effect in combination and (4) a study of rock phosphate in comparison with steamed bone meal and acid phosphate equal money values of each being used.

(o) An experiment to determine how nearly soil fertility can be maintained with (1) live stock or mixed farming and (2) by means of grain farming only.

(p) A study of dry land farming including (1) deep and shallow plowing (2) frequently cultivation (3) cultivating small grain and (4) the introduction of humus forming substances.

(q) The effect of weeds (1) on moisture dissipation and (2) on crop yield.

(r) Breeding for high egg producing hens.

(s) Effect of in and inbreeding on hens.

(t) (1) Effect of yarding compared with free range on egg production and (2) upon the growth and stamina of chicks.

(u) Methods of winter housing.

(v) An experiment to determine the amount of manure accumulated per horse per year when engaged in farm work.

(w) A trial to ascertain the loss of fertilizing constituents from stable manure when composted and the source of loss.

(x) A study designed to learn the seasonal distribution of labor and the general economy of the time employed in producing the standard crops of the Northwest.

(y) Gathering data from co-operating farmers to ascertain the cost of production of different farm crops and animals and the best way to fit them into an economic system of farm management.

DEMONSTRATION FARMS

The work on the twenty-four demonstration farms is presented in the annual report of Demonstration Farms and consists in the same lines as reported upon in previous years.

Alfalfa trials have been expanded, however, to include several where the production of seed in cultivated rows is introduced.

The production, inspection and sealing of pedigreed seeds has been greatly extended and the quantity now seems ample to meet the demand. Eleven carloads of pedigreed seed grain is offered by our co-operative Demonstration Farm managers and the Experiment Station this year.

SUB-EXPERIMENT STATIONS

The work of the five Sub-Stations has been carried forward along similar lines to those followed in former years. Their value and importance to their respective communities is increasing annually and the public appreciation and use of them has steadily grown from the start.

The Hettinger Sub-Station has been without funds the past year which allowed comparatively little experiment work to be carried on there.

I have given you the Sub-Station work in detail in their respective annual reports.

Respectfully submtted,

J. H. SHEPPERD,

Agriculturist and Vice-Director.

CHEMICAL DEPARTMENT

To J. H. Worst, Director:

Sir: The present is the twenty-third Annual Report made by the writer as Chemist for the Experiment Station, covering the calendar year of 1912. The work of the Department has covered a wide range of subjects not only in research lines but in connection with the enforcement of the Food and Drug Laws, which it is made the duty of this Department to supervise. In connection with the enforcement of the various police provisions it has been necessary to carry on many lines of research and make many chemical tests, the results of which have been published in special bulletins during the year or will be found in Parts II and III of the Annual Report from the Food Department, which will contain much data with regard to agricultural problems as well as food matters.

It has been necessary to divide the work of the Department, as in previous years, into several divisions with a chief at the head of each. The principal divisions at the present time are as follows:

1. Agricultural Chemistry—J. W. Ince.
2. Industrial Chemistry—W. F. Washburn.
3. Oil Testing Laboratory—R. Darner.
4. Food Chemistry—R. E. Remington.
5. Physiological Chemistry—H. L. White.
6. Water Analysis—Adele Shepperd.
7. Pharmacy—A. Ziefle.
8. Beverages—W. F. Sudro.
9. Milling Experiments—T. Sanderson.
10. Flour Testing—W. L. Stockham.
11. Baking and Testing Laboratory—L. M. Thomas.
12. Illuminating Oils and Gasolines—W. L. Stockham.
13. Materia Medica—A. F. Schlichting.
14. Micro Chemistry—J. H. Wright.
15. Inspection—L. A. Congdon and C. P. Guthrie.

A sharp line cannot be drawn between the several divisions of work and each division must necessarily over-lap the others and at times assist in caring for the work in another division, but the principal lines of work as given above have been generally adhered to.

I am presenting, herewith, only the report of Professor J. W. Ince dealing with the experiments carried on in the growing of sugar beets.

SUGAR BEETS IN NORTH DAKOTA

Introductory Note

The subject of sugar beet culture is rapidly gaining interest among the farmers in various sections of North Dakota. The establishment of successful factories in the neighboring states of Montana and Minnesota has led our farmers and business men to anticipate the same possibilities for our own state.

In this report we present a summary of all the experimental work done upon this subject in North Dakota by the Experimental Station, in order to prove that beets containing a high percentage of sugar with a high percentage of purity may be grown in many parts of the state. Since there is no factory in this state, there is no prospect of an immediate financial return to those farmers who grow sugar beets. On the other hand, the beets make a desirable stock food and leave the soil in excellent condition for future crops. And the knowledge that the data he secures may help the state in the effort to locate a beet sugar factory here ought to partly compensate the grower for his time and labor.

Statement of Sugar Beet Experiments in North Dakota.

In the year 1891, the interest manifested in the state led the Station, in connection with the State Commissioner of Agriculture, to give considerable attention to the subject. Mr. Helgesen, Commissioner of Agriculture, sent out sugar beet seed to about eight hundred farmers in all parts of the State to be grown and tested for sugar production. The Experiment Station also sent out three varieties of sugar beet seed to a few farmers in different localities of the State for special testing, and the three varieties were grown upon the Station grounds.

The following summary of the experiments in 1891 appeared in Bulletin No. 5 of this Station:

"1. The one hundred and twenty-nine (129) samples of beets analyzed gave an average sugar content (sucrose) of 11.43 per cent.

2. Many of the samples of beets sent out for analysis were harvested before the sugar in the beets was fully formed—in other words, before the beets were ripe.

3. In many cases the beets had not received proper treatment and much of the root grew above the ground.

4. In many instances the ground was not plowed to sufficient depth, not more than six inches deep, leaving a hard, impenetrable

subsoil below, and the beets grew prongy and of ill shape such as would be rejected at the factory.

5. To grow sugar beets for the factory, the land should be plowed or subsoiled to a depth of eight to ten inches; and the beets grow well in the ground, for the part above ground is of inferior quality and generally rejected at the factory.

6. The large beets are not best for sugar. Beets weighing above three pounds have a less per cent of sugar than the smaller beets.

7. For the present, it is my belief that for the most of North Dakota other industries will be found more profitable for both manufacturer and farmer than the sugar beet industry.

(Signed) E. F. Ladd.''

In Bulletin No. 35 of this Station are the following statements concerning the experiments of 1897 and 1898.

''The beets for 1891 were from all parts of the State, more largely from the eastern central and northern parts of the State. Since that date the better knowledge secured regarding the climatic and soil conditions necessary for developing the sugar beet industry, and the further knowledge of the climatic and soil conditions for North Dakota, has led us to look with more hope for success in portions of the State. Notably, is this true for the southern tier of counties east of the Missouri River. In 1891 only ten samples of beets were received from this locality, and some of those had not been grown upon ground suitably prepared, but for these ten samples the average content was 12.9 per cent, the highest being 15.23 per cent. In 1897 it was decided to make a few further experiments in this section, but the season was so unfavorable that the experiment may almost be called a failure. A dry spring left the seed in the ground twenty or thirty days before germination, and then the almost flood rains of July sent the weeds forward so rapidly that there seemed little chance for beets to thrive, and later a disease attacked the leaves, which gave us beets of low sugar content. In spite of the many obstacles to success a few of the samples showed by analysis from 13 to 16 per cent of sugar in the juice.''

''In the spring of 1898, seeds were sent to fifty farmers in the southern tier of counties and of these but sixteen compiled with the Station request and sent samples of the beets harvested for analysis. The variety grown was the Original Klien Wanzleben sugar beet. The seed was secured through Meyer & Raapke, Omaha, Neb. An inspection of the results shows an average of 14.38 per cent of sugar in the juice and a co-efficient of purity 79.4. This makes a good showing, and, as in many instances, the beets did not receive proper care, nor was the ground properly plowed for beet growing, it is safe to say better results would be secured under proper conditions. We have one instance where the beet juice contained 20.20 per cent of

sugar with a purity of 84.2. This is certainly a most excellent showing.''

''From the results of experiments thus far made, it is believed that the southern tier of counties east of the Missouri River is well adapted to sugar beet growing and that the industry might be made a profitable one with Oakes as a center to supply a factory that would be capable of producing all the sugar consumed in the State.''

Results for the year 1899 appeared in the 10th Annual Report of this Station. An average of eighty-two (82) samples of beets gave 12.9 per cent. sugar with 78 per cent purity. Besides the fact that the year was unfavorable, the ground was not properly prepared, nor the beets well cared for.

Results for the year 1900 appeared in the 11th Annual Report of this Station. An average of forty-nine (49) samples of beets gave 9.81 per cent sugar with a purity of 65. The growing season this year was very unfavorable; the wheat and hay crop being the poorest in the history of the State. The first part of the season was very dry, but the latter, warm and wet. Only forty-two out of three hundred and twenty-five farmers could grow any beets whatever.

Results for the year 1911 appeared in Part II of the 22nd Annual Report of the Station. The seed used came from the Bureau of Plant Industry, U. S. Department of Agriculture, except where otherwise stated. Seed was furnished to sixteen (16) farmers, only eleven (11) of whom sent in samples. An average of twenty (20) samples analyzed showed 14.56 per cent sugar and 76.7 per cent purity. Table I. shows the relation of the sugar content to dry matter and weight. Tables II and III show the relation of the date of harvesting and size to the sugar content of the samples grown at the Agricultural College.

TABLE I.

Showing the Relation of Sugar to Dry Matter and Weight, Season 1911.

Average % Sugar	Average % Dry Matter	Average Wt. Grams	Samples Represented
10.75	17.52	1,917	2
11.30	19.80	1,217	2
12.7	21.05	1,095	3
13.3	21.7	802	3
14.6	24.7	681	6
15.3	24.3	737	2
16.5	24.7	682	3
17.6	28.8	400	1

TABLE II.

Showing the Percentage of Sugar in Relation to Date of Harvesting and Size, Season 1911.

Date	Average Per Cent Sugar	Weight (Grams)
October 5th	10.9	1,775
October 17th	10.6	2,060
October 30th	11.0	2,000
October 17th	12.9	921
October 30th	13.8	1,000

TABLE III.

Showing the Relation of Size to Sugar Percentage, Season 1911.

Date	Average Per Cent Sugar	Weight (Gram)
October 30th	14.7	355
October 30th	13.8	1,000
October 30th	11.0	2,000

Results for the season of 1912 are reported in detail in the following pages. The seed of the Klein Wanzleben variety was furnished by the Bureau of Plant Industry, U. S. Department of Agriculture. It was not at all satisfactory, as in some cases the co-operators reported hardly any germination. Seed of the Wohanka varieties was kindly donated by their representative in Detroit, Mich., Mr. Chas. W. de Rekowski. The other seed was secured by the persons submitting the samples and the source is unknown to us.

This Division furnished seed to sixty-seven (67) persons and

from other sources the seed was furnished to twenty-two (22) persons, making a total of eighty-nine. Out of this number thirty-eight (38) sent in samples; eight reported they had failed to secure a stand, either by lack of germination or unfavorable weather conditions; eleven reported they had not planted the seed and twenty-five (25) failed to make any report whatever. The average of fifty-four samples analyzed was 14.04 per cent sugar and 80.2 per cent purity. Table IV shows the relation of the sugar content to dry matter, ash, and weight. Table V. shows the relation of the samples grown on the College grounds. Table VI. shows the relation of the date of harvesting to the percentage of sugar.

TABLE IV.

Showing the Relation of Sugar Content to Dry Matter, Ash and Weight, 1912.

Figures in Average %.

Sugar	Dry Matter	Ash	Weight (Grams)	Samples
11.5	18.7	1.29	744	4
12.5	19.6	1.33	911	5
13.5	21.6	1.22	701	7
14.5	21.2	1.09	926	11
15.3	22.3	1.06	674	7
16.4	23.3	0.98	812	5
17.5	25.0	1.07	687	4
19.1	26.6	0.94	499	3

TABLE V.

Showing the Relation of Sugar Content to Dry Matter, Ash, and Size of Beet. Samples Grown on Agricultural College Grounds in Co-operation with the Agricultural Department.

Variety	Date	% Sugar	% Dry Matter	% Ash	Weight (Grams)
Kleinwanzleben	Sept. 28th	12.9	20.7	0.96	926
	Oct. 30th	13.3	22.8	0.84	952
	Nov. 12th	15.1	22.0	0.85	635
Wohanka, E. R.	Sept. 28th	10.1	17.5	1.16	898
	Oct. 30th	14.3	20.4	1.00	1,278
	Oct. 30th	15.4	20.4	0.94	574
	Nov. 12th	13.2	20.4	1.02	658
Wohanka, Z. R.	Sept. 28th	11.3	19.6	0.98	641
	Oct. 30th	12.8	19.7	1.11	1,095
	Oct. 30th	15.3	22.5	0.83	473
	Nov. 12th	14.3	21.8	0.91	609
Average of all Samples	Sept. 28th	11.4	19.2	1.03	822
	Oct. 30th	14.2	21.1	0.94	874
	Nov. 12th	14.2	21.4	0.92	634

TABLE VI.

Showing the Relation of Sugar Content to Date of Harvest.
Season 1912.

Range in Dates	Per Cent Sugar	Samples Represented
Sept. 23rd—Oct. 7th	12.2	11
Oct. 14th—Oct. 19th	15.1	19
Oct. 26th—Oct. 31st	14.2	16
Nov. 1st—Nov. 12th	15.3	10

COMMENTS UPON THE DATA OF 1912.

An examination of the reports of the co-operators who submitted samples will show that the beets in most cases did not receive the attention they should in order to give roots with a high percentage of sugar. The same conditions which limited the success of the experiments of former years in this State were manifest in 1912. They might be stated as follows:

(1) These trials are merely experiments with no direct financial returns; hence if the beets are planted at all, it will be done in the majority of cases not sufficiently cultivated or weeded.

(2) In the majority of cases the soil has not been properly prepared, not plowed deeply enough, nor dragged and pulverized sufficiently.

(3) The beets have not been given proper attention while growing; in a great many cases not being blocked or thinned at all, and in the majority of cases not sufficiently cultivated or weeded.

(4) In many cases the beets have been harvested too early to allow for the maximum production of sugar.

There is no doubt that the previous crops exert more or less of an influence upon sugar beets, but no attempt has been made to analyze the data presented here since the other factors are not uniform, and it is doubtful if this particular influence could be accurately judged in these instances.

It can quite readily be seen from a study of the tables referred to above that the smaller the beets, the higher the percentage of sugar; the longer the beets are left in the ground (provided there is no second growth) the more sugar they contain. Under favorable climatic conditions beets can be left in the ground till the first week in November without injury. Further, the percentage of sugar and dry matter in the pulp follow each other very closely; the percent-

age of ash is quite regularly proportional to the weight of the beet; though the richer the beet in sugar, the less the weight of the beet and the lower the percentage of ash.

RESULTS OF SUGAR BEET EXPERIMENTS

Laboratory No.	County	Town	Grower	Variety
31	Barnes	Hastings	L. Reiten	K. W.
32	Barnes	Valley City	M. C. James	W. Z. R.
41	Barnes	Valley City	C. J. Lee	—?—
43	Barnes	Valley City	S. S. Aas	—?—
	Average for County			
1	Burleigh	Bismarck	F. O. Hellstrom	W. Z. R.
22	Cass	Amenia	E. Iwen	K. W.
37	Cass	Fargo	T. Nesbitt	W. E. R.
36	Cass	Fargo	T. Sanderson	W. E. R.
35	Cass	Fargo	T. Sanderson	W. Z. R.
17	Cass	A. C.	Agricultural Dept.	Vil.
18	Cass	A. C.	Agricultural Dept.	K. W.
2	Cass	A. C.	Chemical Dept.	W. E. R.
3	Cass	A. C.	Chemical Dept.	W. Z. R.
4	Cass	A. C.	Chemical Dept.	K. W.
44	Cass	A. C.	Chemical Dept.	W. E. R.
45	Cass	A. C.	Chemical Dept.	K. W.
46	Cass	A. C.	Chemical Dept.	W. Z. R.
47	Cass	A. C.	Chemical Dept.	W. E. R.
48	Cass	A. C.	Chemical Dept.	W. Z. R.
70	Cass	A. C.	Chemical Dept.	K. W.
71	Cass	A. C.	Chemical Dept.	W. Z. R.
72	Cass	A. C.	Chemical Dept.	W. E. R.
	Average for County			
5	Cavalier	Langdon	E. D. Stewart	K. W.
6	Cavalier	Langdon	E. D. Stewart	W. Z. R.
	Average for County			
7	Dickey	Oakes	A. Dahlbeck	K. W.
16	Divide	Colgan	H. Colgan	K. W.
30	Grand Forks	Larimore	A. Stonehouse	—?—
38	Grand Forks	Meckinock	M. Sherdahl	K. W.
	Average for County			
56	Kidder	Steele	E. M. Wiley	K. W.
51	LaMoure	Edgeley	O. A. Thompson	W. Z. R.

AND ANALYSES FOR SEASON OF 1912.

Per Cent Sugar in Beet	Per Cent Purity Coefficient	Per Cent Solids in Juice	Per Cent Solids in Pulp	Per Cent Ash	Average Weight (Gram.)	Number of Beets Analyzed	Condition of Sample	Dates Shipped and Analyzed
14.8	79.6	18.62	22.70	1.21	955	2	Good	Oct. 19-21
16.0	81.2	19.71	23.92	1.16	703	9	Fair	Oct. 19-21
12.0	74.3	16.15	20.20	1.55	651	5	Good	Oct. 29-31
14.6	81.1	18.00	21.52	1.04	1400	4	Good	Oct. 29-31
14.35	79.0							
12.4	78.0	15.90	21.44	x	734	9	Good	Sept. 23-28
15.2	84.4	18.00	21.78	1.02	1308	5	Good	Oct. 16-19
14.6	84.6	17.26	16.70	0.93	565	11	Good	Oct. 26-26
15.0	74.3	20.18	23.00	1.50	687	6	Dry	Oct. 25-26
14.4	75.2	19.14	20.38	1.43	848	7	Dry	Oct. 25-26
13.7	77.8	17.66	21.43	1.35	960	6	Poor	Oct. 14-16
11.3	77.3	15.31	17.94	1.45	808	6	Poor	Oct. 14-16
10.1	71.7	14.07	17.48	1.16	898	6	Good	Sept. 28-Oct. 1
11.3	70.5	15.97	19.63	0.98	641	6	Good	Sept. 28-Oct. 1
12.9	76.9	16.76	20.68	0.96	926	6	Good	Sept. 28-Oct. 1
15.4	96.6	15.93	20.44	0.94	574	10	2nd Growth	Oct. 30-31
13.3	72.6	18.32	22.80	0.84	952	8	2nd Growth	Oct. 30-31
15.3	86.2	17.74	22.50	0.83	473	7	2nd Growth	Oct. 30-31
14.3	87.3	16.36	20.38	1.00	1278	5	2nd Growth	Oct. 30-31
12.8	78.5	16.30	19.74	1.11	1095	6	2nd Growth	Oct. 30-31
15.1	86.5	17.46	22.06	0.85	635	10	Good	Nov. 12-13
14.3	81.1	17.63	21.88	0.91	609	7	Good	Nov. 12-13
13.2	79.4	16.63	20.45	1.02	658	8	Good	Nov. 12-13
13.65	80.0							
11.8	71.3	16.53	20.78	1.09	337	5	Fair	Oct. 4-7
13.8	71.9	19.19	23.56	0.86	346	5	Dry	Oct. 4-7
12.8	71.6							
7.75	62.7	12.35	16.05	1.25	915	6	Good	Oct. 4-7
14.5	79.2	18.30	22.70	1.28	633	4	Good	Oct. 14-17
11.4	73.4	15.53	19.06	1.22	985	2	Good	Oct. 18-21
15.4	82.1	18.76	22.92	1.18	737	4	Fair	Oct. 26-29
13.4	77.7							
12.4	75.3	16.46	20.40	1.34	194	5	Poor	Nov. 2-4
13.3	75.5	17.61	21.28	1.44	596	6	Dry	Oct. 31-Nov. 2

RESULTS OF SUGAR BEET EXPERIMENTS

Laboratory No.	County	Town	Grower	Variety
33	McLean	Underwood	R. Nelson	K. W.
69	McLean	Washburn	A. Peterson	W. Z. R.
	Average for County			
34	McHenry	Towner	Sargent Bros.	—?—
49	Morton	Glen Ullin	P. W. Schultz	W. Z. R.
8	Mountrail	White Earth	B. Holte	—?—
14	Ransom	McLeod	M. Reinholt	K. W.
11	Richland	Wyndmere	M. Puetz	K. W.
9	Richland	Fairmount	W. H. Lawson	K. W.
39	Richland	Fairmount	J. Steffens	W. Z. R.
53	Richland	Fairmount	J. Rubish	W. Z. R.
54	Richland	Fairmount	L. N. Abbott	K. W.
55	Richland	Fairmount	J. Damman	W. E. R.
57	Richland	Fairmount	G. R. Slocum	W. Z. R.
58	Richland	Fairmount	H. E. Wiar	W. Z. R.
	Average for County			
42	Sargent	Havana	P. C. Brougher	W. Z. R.
19	Sheridan	McClusky	V. Curtis	K. W.
15	Stutsman	Medina	A. F. Reardon	K. W.
40	Traill	Clifford	O. Rygg	K. W.
50	Traill	Mayville	F. Vonesh	—?—
52	Traill	Mayville	A. Vinje	—?
	Average for County			
23	Williams	Williston	E. G. Schollander	K. W.
24	Williams	Williston	E. G. Schollander	K. W.
25	Williams	Williston	E. G. Schollander	Vil.
26	Williams	Williston	E. G. Schollander	—?—
	Average for County			

AND ANALYSES FOR SEASON OF 1912.

Per Cent Sugar in Beet	Per Cent Purity Coefficient	Per Cent Solids in Juice	Per Cent Solids in Pulp	Per Cent Ash	Average Weight (Grams)	Number of Beets Analyzed	Condition of Sample	Dates Shipped and Analyzed
14.9	80.6	18.48	22.57	0.95	1110	6	Good	Oct. 19-22
17.6	82.2	21.41	25.58	1.01	671	6	Dry	Nov. 8-11
16.2	81.4							
17.6	77.7	21.36	25.32	1.01	291	6	Good	Oct. 19-22
13.4	80.5	16.65	21.33	1.55	876	6	2nd Growth	Oct. 29-Nov. 2
11.4	80.2	14.20	17.44	1.39	845	4	Good	Oct. 4-7
16.7	87.9	18.98	22.98	0.69	943	6	Fine	Oct. 14-16
12.0	74.8	16.04	18.65	1.27	873	6	Fine	Oct. 14-15
13.8	81.9	16.84	20.59	1.05	586	4	Good	Oct. 7 8
12.0	75.9	15.81	19.12	1.37	1741	5	Good	Oct. 26-29
16.0	84.6	18.91	23.08	0.92	672	8	Good	Nov. 1-2
15.6	87.6	17.81	23.31	1.03	311	6	2nd Growth	Nov. 1-2
14.1	80.6	17.50	21.13	1.02	688	7	Good	Nov. 1-2
16.6	82.8	20.05	22.93	0.82	676	7	Good	Nov. 7-9
18.1	86.9	20.82	24.17	0.70	338	6	Good	Nov. 7-9
14.8	81.9							
19.7	90.0	21.90	26.74	1.29	741	6	Poor	Oct. 29-31
19.5	87.8	22.21	27.01	0.84	420	4	Poor	Oct. 16-18
15.6	84.9	18.37	22.52	0.98	631	3	Fair	Oct. 14-16
14.7	81.0	18.15	22.15	0.90	1125	4	Good	Oct. 29-31
14.6	91.6	15.94	21.34	0.92	607	6	Dry	Oct. 30-Nov. 2
13.0	77.5	16.77	20.87	x	610	1	Dry	Oct. 30-Nov. 2
14.1	83.4							
17.5	84.9	20.60	24.61	1.25	950	3	Good	Oct. 16-19
17.2	84.7	20.29	24.49	1.03	838	3	Good	Oct. 16-19
16.6	85.1	19.54	23.36	1.29	1007	3	Good	Oct. 16-19
14.6	77.6	18.82	21.94	1.34	983	3	Good	Oct. 16-19
16.47	83.0							

DATA CONCERNING

Lab. No.	Date of Plowing	Depth of Plowing	Date of Planting	Date of Thinning	Kind of Soil
31	July, 1911	7-8 inches	May 3	June 10	Clay loam
32	(No report submitted.)				
41	(No report submitted.)				
43	(No report submitted.)				
1	Spring	8 inches	June 5	Never	Heavy black, manured
22	Fall	5 inches	May 15	June 27	Sandy loam
37	(No report submitted.)				
36	x	x	May 15	(report incomplete)	
35	x	x	May 15	(report incomplete)	
17	(No report submitted.)				
18	(No report submitted.)				
2	Spring	6 inches	April 27	June 18	Heavy black clay
3	Spring	6 inches	April 27	June 18	Heavy black clay
4	Spring	6 inches	April 27	June 18	Heavy black clay
44	Spring	6 inches	April 27	June 18	Heavy black clay
45	Spring	6 inches	April 27	June 18	Heavy black clay
46	Spring	6 inches	April 27	June 18	Heavy black clay
47	Spring	6 inches	April 27	June 18	Heavy black clay
48	Spring	6 inches	April 27	June 18	Heavy black clay
70	Spring	6 inches	April 27	June 18	Heavy black clay
71	Spring	6 inches	April 27	June 18	Heavy black clay
72	Spring	6 inches	April 27	June 18	Heavy black clay
5	(No report submitted.)				
6	(No report submitted.)				
7	Spring	7 inches	May 5	Never	Sandy
16	x	5 inches	June 20	July 20	Clay loam
30	(No report submitted.)				
38	Spring	7 inches	May 7	June 10	Black loam
56	Spring	12 inches	May 28	July 1	Black loam

SUGAR BEETS.

Two Previous Crops	Germination	Stand	Moisture Conditions	General Condition of Crop	Weeds
Fallowed	slow & uneven	x	Good	Good but uneven	Yes
Cabbage	Good	Good	x	Thick and heavy	No
Barley, wheat	40%	Good	Good	Good	Some
Alfalfa	Good	Good	Good	Good	Yes
Alfalfa	Good	Good	Good	Good	Yes
Alfalfa	Poor	Poor	Good	Good	Yes
Alfalfa	Good	Good	Good	Good	Yes
Alfalfa	Poor	Poor	Good	Good	Yes
Alfalfa	Good	Good	Good	Good	Yes
Alfalfa	Good	Good	Good	Good	Yes
Alfalfa	Good	Good	Good	Good	Yes
Alfalfa	Poor	Poor	Good	Good	Yes
Alfalfa	Good	Good	Good	Good	Yes
Alfalfa	Good	Good	Good	Good	Yes
Garden	Very poor	Poor	x	x	Yes
	x	x	Good	Late	x
Wheat, oats	15%	Poor	At first deficient	Not good	Yes
Turnips, beans	Fair	Medium	Good	Good	Yes

DATA CONCERNING

Lab. No.	Date of Plowing	Depth of Plowing	Date of Planting	Date of Thinning	Kind of Soil
51	(No report submitted.)				
33	x	9 inches	May 15	June 27	Black
69	x	8 inches	May 1	June 15	Sandy clay
34	Spring	6 inches	June 11	Never	Sandy loam
49	Spring	10 inches	May 18	Never	Sandy loam
8	Spring	4 inches	June	Never	Clay subsoil
14	Spring	7-8 inches	May 22	June 25	Fine sandy loam
11	Fall	8 inches	June 1	—?—	Rich silt
9	Fall	6 inches	May 25	Never	Black loam
39	(No report submitted.)				
53	Spring	4 inches	May 10	June 5	Black loam
54	Spring	5 inches	x	x	Clay loam
55	(No report submitted.)				
57	Spring	7 inches	June 1	July 1	Black loam
58	Fall	5 inches	x	x	Black loam
42	Spring	6 inches	May 19	June 12	Black loam
19	Spring	8 inches	May 25	June 25	Loam
15	Spring	6 inches	May 15	July 1	Sandy loam
40	Spring	10 inches	May 24	July 3	Fine sandy
50	Spring	7 inches	May 25	x	Sandy
52	(No report submitted.)				
23	Fall	8-10 inches	May 14	June 17	Loam
24	Fall	8-10 inches	May 14	June 17	Loam
25	Fall	8-10 inches	May 14	June 17	Loam
26	Fall	8-10 inches	May 14	June 17	Loam

SUGAR BEETS.

Two Previous Crops	Germination	Stand	Moisture Conditions	General Condition of Crop	Weeds
Oats, potatoes	Poor	Fair	Plenty	x	Yes
x	x	x	Too much at first	Fair	x
Prairie, garden	x	Good	Abundant after July 1	x	No
Corn, potatoes	x	Thin	Dry	x	x
Corn, mangels	x	Good	x	Fair	Yes
Potatoes, garden	Poor	Thin	Good	Fair	Yes
Garden	Good	Good	x	Good	No
Wheat, x	Poor	Thin	Dry at first	Good	Yes
Beans, corn	Very good	Good	Fair	Good	Yes
Wheat, garden	Very good	Good	Plenty	Fair	No
Wheat, oats	Fair	Good	x	Fair	Yes
Wheat, oats	Good	Good at first	Too much	Poor	Yes
Wheat, potatoes	Good	x	Good	Poor	Yes
x, potatoes	20%	x	Plenty	x	Yes
Corn garden	50%	Good	Too much	Fine	Some
Wheat, oats	x	Fair	Plenty	Good	Yes
Potatoes, wheat	x	Poor	Plenty	Poor	No
Garden	Fair	Fair	x	Extra good	No
Garden	Fair	Fair	x	Extra good	No
Garden	Fair	Fair	x	Extra good	No
Garden	Fair	Fair	x	Extra good	No

SUMMARY OF RESULTS BY YEARS.

1891—

	K. W.	Desprez	VII.	R. I.	Lamaire
Number of samples.....	14	84	10	2	5.
Average % of sugar....	12.5	11.3	10.9	10.0	12.2

Average of 129 samples—11.43% sugar.

1899—

	Vil.	Zehringen	Mangold
Number of samples	11	12	64
Average % of sugar	13.96	12.55	12.85
Average % purity	62	81	79

Average of 82 samples—12.9% sugar; 78% purity.

1900—

	Vil.	Zehringen	K. W.	Dippe Bros.	Russian
Number of samples	26	6	3	5	8
Average % sugar	9.8	9.53	10.87	9.22	9.76
Average% purity	69	64	71	67	68

Average of 49 samples—9.81% sugar; 65% purity.

1911—

	Vil.	Idaho	K. W.	Unknown
Number of samples	1	1	12	6
Average % sugar	16.70	16.90	13.86	15.23
Average % purity	80.6	81.0	76.7	76.2

Average of 20 samples—14.56% sugar; 76.7% purity.

1912—

	Vil.	W. E. R.	W. Z. R.	K. W.	Unknown
Number of samples	2	7	15	22	8
Average % sugar	5.15	13.8	14.5	14.6	13.65
Average % purity	81.4	82.0	79.4	80.6	79.1

Average of 54 samples—14.04% sugar; 80.2% purity.

Abbreviations—

K. W.—Klein Wanzleben.
R. I.—Russian Imperial.
W. Z. R.—Wohanka's richest in sugar.
W. E. R.—Wohanka's heaviest yielder.
Unknown—Samples from persons to whom we did not furnish seed and who did not indicate the variety.
Vil.—Vilmorin's Improved white.

SUMMARY OF RESULTS BY COUNTIES.

Counties	Number of Years	Number of Trials	Average Per Cent Sugar	Per Cent Purity Coefficient
Barnes	6	13	13.18	75.3
Benson	3	6	11.33	67.0
Bottineau	3	..	12.70	72.0
Burleigh	4	5	12.45	78.0
Cass	6	39	12.70	77.6
Cavalier	3	12	11.46	71.5
Dickey	4	12	12.27	73.8
Divide	1	1	14.50	79.2
Eddy	2	8	13.04	75.3
Emmons	2	4	13.27	78.5
Foster	1	2	13.35	64.0
Grand Forks	5	17	12.32	77.6
Kidder	3	6	10.50	66.5
Lamoure	4	11	12.63	78.1
Logan	1	1	13.40	79.0
McHenry	3	3	13.41	71.2
McIntosh	2	3	12.42	79.0
McLean	2	3	15.80	81.6
Morton	2	2	14.15	76.7
Mountrail	2	2	10.71	74.0
Nelson	2	3	12.96	79.0
Pembina	4	13	12.20	84.1
Pierce	2	2	12.15	72.0
Ramsey	1	5	11.12	77.6
Ransom	4	9	12.05	75.4
Richland	6	24	13.22	74.0
Rolette	4	10	12.51	70.7
Sargent	5	14	13.93	82.3
Sheridan	1	1	19.50	87.8
Stark	3	3	14.14	83.6
Steele	2	6	11.58	82.4
Stutsman	5	15	12.77	76.5
Traill	5	22	13.16	76.0
Towner	2	3	13.18	74.8
Walsh	5	6	14.17	82.2
Ward	1	1	10.56	80.0
Wells	2	11	13.84	75.6
Williams	5	16	15.95	80.7

No analyses or trials reported for the following Counties: Adams, Billings, Bowman, Dunn, Griggs, Hettinger, McKenzie, Mercer or Oliver.

SUMMARY OF SUGAR BEET EXPERIMENTS.

Year	Number of Trials	Average Per Cent Sugar	Average Per Cent Purity Coefficient
1891	129	11.43	
1898	15	14.38	79
1899	82	12.90	78
1900	49	9.81	65
1905	6	13.40	74
1907	3	13.30	x
1908	20	14.30	83 (average of 7.)
1910	7	16.3	79
1911	20	14.56	76
1912	54	14.04	80
Grand Total	385	12.46	76

GENERAL SUMMARY

1. A resume is given in this report of all sugar beet experiments and analyses carried on in North Dakota. There are shown here tables giving the results by counties, years and by varieties.

2. The results for the season of 1912 are also given with statements how the beets were raised; and tables showing the effect upon the sugar content of the time when harvested; the size of the beet; and its mineral contents.

3. The average of all trials reported (385) is 12.46% sugar and 76% purity, representing ten different seasons.

4. Considering the fact that there are many reasons why successful sugar beet culture is exacting in its demands upon the farmer, and that the samples sent in to be analyzed have generally been more or less indifferently grown, the above averages are fairly satisfactory.

5. It is possible to grow sugar beets of 12% or more sugar in the greater portion of the state. The averages by counties show that the northern tier can grow beets as successfully as the southern tier. There seems to be, however, quite favorable conditions for beets of high sugar content along the Missouri.

6. Certain varieties, or certain strains of the same variety, give more favorable results from year to year. It is possible that with careful selection of a variety suited to North Dakota conditions, i. e., early maturing and capable of digesting much alkaline material without harmful effect upon the sugar content, still better results can be secured.

Note: Acknowledgement is hereby made of the assistance of Mr. E. B. Hunt, who performed the bulk of the determinations for the seasons of 1911 and 1912.

Credit is also due to those farmers who have co-operated with us in growing the beets. Their efforts are duly appreciated.

Respectfully submitted,

E. F. LADD,

Chemist.

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY

Director J. H. Worst:

Dear Sir:—

I herewith submit the Annual Report of the Department of Botany. It does not seem advisable to go into details at this time inasmuch as the experiments which we have been working upon for a number of years have reached such a stage in their development that it is necessary for us to prepare a number of bulletins giving these experiments in detail.

I may say that we have kept going the regular lines of experimentation which have been running for a number of years. We have also started a number of preliminary experiments which are indicated by the results arising from our regular investigation.

The Work With Flax, as is clearly indicated in our previous bulletins has proven clearly that the so-called deterioration of the soil which had usually been supposed to have occurred, was based on error. It has been proven clearly that the troubles with the flax crop merely rested in an unsanitary condition of the soil and seed and not in deteriorated soil nor particularly in physical condition of the soil.

The Work With Potates:—We have continued plot work with potatoes and breeding work on potatoes and find that potato troubles such as scab and rot and blight bring about soil troubles for potatoes very similar to those described for flax, but as this crop is grown upon a more limited area the farmers have gradually learned the extreme importance of soil purification by cultivation and rotation and the marked importance of seed disinfection and vine disinfection with the result that the problem of potato cropping has essentially been solved, and now rests only in the proper extension of information to farmers.

The Work With Wheat:—In the work with wheat, under the Adam's Investigation, we have carried forward a large series of properly checked and guarded experiments and have lived so closely in the field with the crop while growing as to attain conclusions which are far reaching, if we are right. These conclusions are essentially this: that the so-called deterioration of wheat, under constant cropping is not due primarily to lost fertility, but rather to unsanitary conditions of seed and soil and to the unsanitary methods of handling farm fertilizers and the unsanitary methods of arranging

crop rotations. In other words, we have come to such conclusions as will allow us to assert that the theory as to conditions of deterioration usually mentioned by the chemist as due to lost nitrogen, lost humus, deficiency in phosphates, lime, etc., is not primarily correct. Therefore the reasons usually given for crop rotation, namely, that such crop rotation improves the crop because of material modification of the fertility is not well based. I believe that eventually we will be able to write such a classification of proper crops in rotation as to essentially eliminate the so-called deterioration now mentioned, provided proper methods of seed selection, seed disinfection and manure application are also arranged for.

The details of these experiments cannot be given in one or two publications, but will follow in an orderly manner the general statement of conditions. When proper arrangement is made with reference to soil and seed sanitation and manure purification large amounts of certain types of fertilizers and manure may be applied without harm as has been proved in the case of potatoes; but as often observed by the practical farmer, the application of fresh barnyard manures is as apt to be harmful as beneficial under the present methods of crop rotation.

Internal Seed Diseases:—Our experiments have conclusively proven that the average wheat seed is internally attacked by from one to many types of parasitic organisms (fungi), any one of which can prevent the production of thoroughly normal seed even on the average new land. These diseases get carried into the barn-yard by way of the straw and rubbish and get carried into the new ground by way of the seed and fresh uncomposted manures, etc.

Deterioration on Native Lands:—Some of these diseases of wheat attack other crops and other native plants, thus in part accounting for the fact that new or virgin sod lands which have lain idle in the interior of the great wheat belt do not now, with any certainty, produce high quality wheat when first plowed as the same type of lands once did. This is further made clear by the fact that the drifting brought about by the wash waters and winds carry the disease from field to field and bring about infection of even these new lands.

Details of this and other experiment work will be given in the regular bulletins of the department and the more practical features will be found expressed in the press bulletins regularly issued by the departments.

Respectfully submitted,

H. L. BOLLEY, Botanist.

HORTICULTURAL DEPARTMENT.

To J. H. Worst, Director:

Sir:

The work in the Department of Horticulture and Forestry was devoted largely to plant improvement along the lines already started and to the investigation of insect ravages.

The improvement of the native plum has been carried about as far as can reasonably be expected without hybridizing with other species to obtain firmness of flesh. This cannot be done without further greenhouse and laboratory facilities.

Some of the trees that came into bearing for the first time in 1912 bore fruit possessing most of the desirable qualities except the firmness necessary in a good shipping fruit.

Observations of the growth and behavior of different forest trees have been made throughout the year.

The black walunt endured the extreme temperature of the winter of 1911-1912 without injury and this, together with its ability to endure drouth as demonstrated in the season of 1911 would indicate that it is likely to prove as valuable in North Dakota as in regions where it is found native. The other species of forest trees make growths similar to that recorded in previous reports.

A disease of the box-elder (Septoria sp.) was reported from several parts of the state and directions were given by this department for its eradication. In some of the towns visited, a portion of the trees were entirely dead and practically all were so badly affected that they could not live for more than a year or two without prompt treatment. The remedy consists of cutting off and burning the greater part of the top, leaving only that part of the limbs having a diameter of an inch or more. As the disease is confined to the twigs and newer growth, this leaves a healthy framework from which a new growth takes place. The trees suffer no permanent damage and the disease is completely disposed of till further infection from an outside source should take place.

Spraying or washing the trees after pruning with a solution of corrosive sublimate will kill any loose spores that may be attached to the bark.

The usual insect enemies of the box elder have been rather more numerous than common. This is particularly true of the cotton maple

scale that has seriously infested the shade trees in the towns. Spraying with a lye solution or with strong kerosene emulsion will kill most of the insects if the work is done while the trees are dormant.

A preliminary pruning such as is recommended for the disease septoria would be more practical in most instances than spraying.

WHEAT INSECTS.

The damage to wheat by insects was much greater than for many years and probably greater than at any time in the history of the state.

A part of the damage was done by the Hessian fly but a far more serious pest was one not yet determined that caused a percentage of the straws to go over shortly after the blossoming period. In some cases, this loss was as high as twenty-five per cent., and for the state, must have averaged five per cent unless there were some regions not visited, where there was little or no damage. As the insect had left the plant before the stalks fell, we did not succeed in getting hold of any specimens for determination. During the coming season we expect to be able to find the insects at work and to determine the species.

In September, 1911, Mr. Stephen B. Johnson, of the Oklahoma Experiment Station, was elected assistant horticulturist of this station.

Respectfully submitted,
C. B. WALDRON,
Horticulturist and Forester.

DEPARTMENT OF VETERINARY SCIENCE

To J. H. Worst, Director:

Sir:

Permit me to submit the following report on the nature of the work done during the annual period terminating January 30, 1913.

During the period mentioned, the investigations on swamp fever were continued. They included a series of tests made with the blood

serum of swamp fever horses and of normal horses and with a view of comparing their inhibitory powers in connection with saponine hemolysis. An apparent increase in this inhibitory power on the part of blood serum taken from horses affected with infectious anemia in Germany caused Abderhalden and his co-workers to recommend such a test as a possible means of diagnosis. As it is more than probable that the infectious anemia of Europe is identical to our own swamp fever, a great number of tests were made in order to determine the usefulness of the method. Those tests showed conclusively that the saponine method of diagnosis cannot be relied upon in our problems.

A considerble amount of time and energy was also devoted in an attempt to make the phenomena of complement fixation available as a means of diagnosis. Those trials are still in progress, although it is to be foreseen at this time that if a complement fixation method at all becomes possible in this disease, it will be limited to only a part of the cases, carrying the infection.

Of considerable importance, from a practical as well as from a scientific view-point, is the discovery made during the year past, that the cellular elements of the blood, deprived of all serum by repeated washing and centrifugation will produce the disease when injected into a susceptible horse.

The observations on swamp fever made during the past year tend to confirm the indications furnished by our experimental data, namely, that there are a number of field cases of swamp fever in which anemia is not a feature and that in so-called recovered cases, the recovery is only an apparent one, inasmuch as the blood of such animals continues to be virulent for long periods, probably during the remainder of the animal's life-time. This feature was well brought out at the conclusion of an experiment made some time ago. Experimental horse No. 636 which received its initial infection on September 9, 1908, and which to all appearances made a recovery was bled on September 9, 1912, and the blood thus obtained injected into a susceptible animal with the result of a positive infection becoming manifest after an incubation of thirty-four days.

With a view of studying possible differences in the character and behavior of swamp fever from different origins, we are now engaged in some observations on animals infected with virus procured in Texas and in the Province of Alberta in Canada.

During the last year some preliminary work was done with a view of finding a way to overcome the difficulties which seem to accompany the manufacture of a reliable hog-cholera serum at this station. We believe it necessary to include this in our work as a regular experimental project and will make some recommendations accordingly as soon as a plan of work has been sufficiently devised and outlined.

During the last two months an excellent opportunity for the study of avian tuberculosis has presented itself through the discovery that this disease affected a considerable number of the members of the station poultry flock. The material thus made available was used in trials with a method of tuberculin testing as a means of culling out infected birds. A considerable degree of success was obtained, but as the work has not been concluded, we propose to publish the final result in a report to be published during the coming year.

We also hope to issue during that time a station bulletin on our experiments on swamp fever made since the publication of the bulletin on this subject in 1911.

Respectfully,

L. VAN ES,
Station Veterinarian.

REPORT OF AGRICULTURAL COLLEGE.

Statement.

United States Appropriations, 1911—1912.

Receipts	Hatch Fund	Adams Fund
	$15,000.00	$15,000.00
To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1912, under acts of Congress approved March 2, 1887, Hatch Fund) and March 16, 1906, (Adams Fund.)	$15,000.00	$15,000.00
DISBURSEMENTS		
Salaries	9,849.00	10,523.02
Labor	3,634.32	1,515.05
Publications	500.00	.....
Postage and Stationery	23.00	13.68
Freight and Express	.....	41.51
Heat, Light and Water	.....	.....
Chemical Supplies	4.70	502.76
Seeds, Plants and Sundry Supplies	64.12	247.19
Fertilizers	29.30	14.35
Feeding Stuffs	.....	523.15
Library	.....	2.54
Tools, Implements and Machinery	119.00	50.98
Furniture and Fixtures	342.66	87.70
Scientific Apparatus	225.78	394.43
Live Stock	.....	647.60
Traveling Expenses	59.05	68.99
Contingent Expenses	25.00	.....
Building and Repairs	124.07	367.05
Total	$15,000.00	$15,000.00